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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of   Atty. Docket

GERARD DE HAAN ET AL.   PHNL 010094

Serial No.: 09/855,628   Group Art Unit: 2613

Filed: May 15, 2001   Examiner: B.M. Senfi

Title: MOTION ESTIMATOR FOR REDUCING HALOS IN MC UP-CONVERSION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Enclosed is an original copy of an Appeal Brief in the above-identified patent application.

Please charge the fee of $500.00 to Deposit Account No. 14-1270.

Respectfully submitted,

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GERARD DE HAAN ET AL.	PHNL 010094
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MOTION ESTIMATOR FOR REDUCING HALOS IN MC UP-CONVERSION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

APPEAL BRIEF

This is an appeal from the Examiner of Group 2613 finally rejecting claims 1-25 in this application.

(i)   Real Party in Interest

.The real party in interest in this application is KONINKLIJKE PHILIPS ELECTRONICS N.V. by virtue of an assignment from the inventors recorded on July 30, 2001, at Reel 012032, Frames 697-698.

(ii)   Related Appeals and Interferences

There are no other appeals and/or interferences related to this application.

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(iii)   Status of the Claims

Claims 1-25 stand finally rejected by the Examiner.

(iv)   Status of Amendments

There was one (1) Response filed on March 14, 2005, after final rejection of the claims on February 16, 2005, this Response having been considered by the Examiner.

(v)   Summary Of Claimed Subject Matter

The invention relates to a method and apparatus for detecting motion in an image signal at a temporal intermediate position between previous and next images, in which a criterion function for candidate vectors is optimized, this function being dependent on data from both previous and next images, and in which the optimizing is carried out at the temporal intermediate position in non-covering and non-uncovering areas.

Appellants have found that an estimator estimating motion between two successive pictures from a video sequence, cannot perform well in areas where covering or uncovering occurs. This is due to the fact that it is typical for these areas that the information only occurs in either one or the other of the two images. Block matchers, as a consequence, will always find large match errors even for the correct vector.

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The subject invention seeks to overcome this problem by carrying out the optimization at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas.

As described in the specification on page 11, line 27 to page 12, line 17, and shown in Fig. 6, the apparatus comprises means 1 for optimizing a criterion function for candidate vectors, an image signal J being applied to the optimizing means 1. In addition, the image signal J is also applied to means 2 for detecting covering/uncovering areas in the image signal J. An output from the detecting means 2 is applied to the optimizing means 1 for switching the functioning of the optimizing means such that the optimizing is carried out, instead of at the temporal intermediate position, at the temporal position of the next image in covering areas, and at the temporal position of the previous image in uncovering areas.

As described on page 12, lines 18-34, a retimer 3 determines a velocity edge X_E and marks an occlusion area around the edge in response to a foreground velocity and a background velocity determined in the image signal J by a foreground/background detector 4. The retimer 3 controls the optimizing means 1 such that in the occlusion area, a foreground velocity is replaced by a background velocity or vice versa, depending on whether the occlusion is a covering or uncovering area, the sign of the

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foreground velocity, and on which side of the velocity edge X_E the

foreground is located.

As shown in Fig. 9, and described in the specification on page

13, lines 1-24, the foreground/background detector 4 includes

calculating means 5 and 6 for calculating, from the image signal J

in response to a covering/uncovering detector 7, a first position

and a second position, and, in response thereto, calculating means

8 for calculating a third intermediate position. The image signal J

and the third intermediate position are used by fetching means 9 to

derive the background velocity V_{BG}.

Alternatively, as shown in Fig. 10 and described in the

specification on page 13, line 24 to page 14, line 8, the

apparatus, and more particularly, the foreground/background

detector 4 includes projecting means 10 and 11 coupled to receive

the image signal J and controlled by a covering/uncovering detector

12. The projecting means projects two positions on either side of

the velocity edge V_E. In response to the projected two positions,

an identification means 14 identifies a background velocity V_{BG} and

projects to a foreground velocity V_{FG}. The foreground/background

detector 4 may include verification means, i.e., checking means 13,

which checks if the two projections yield the same vector.

Alternatively, as shown in Fig. 11 and described in the

specification on page 14, lines 9-27, the apparatus, and more

particularly, the foreground/background detector 4 includes, along

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with a covering/uncovering detector 17, projecting means 16, receiving the image signal J, for projecting, under control of the covering/uncovering detector 17, the discontinuity to the previous vector field in the covering situation and to the future vector field in the uncovering situation. In addition, velocity determining means 18 and 19 are included for determining the velocity on opposite sides of the discontinuity. Testing means 20, coupled to outputs of the projecting means 16 and the velocity determining means 18/19, derives therefrom the background vector V_{BG}.

Finally, as shown in Fig. 12 and described in the specification on page 14, line 28 to page 15, line 2, an image display apparatus is shown including apparatus 21 for detecting a motion vector in accordance with that shown in Fig. 9, interpolating means 22 coupled to an output of the apparatus 21, and a display device 23 connected to an output of the interpolating means.

(vi)   <u>Grounds of Rejection to be Reviewed on Appeal</u>

(A)   The invention, as claimed in claims 1-6, 13-18 and 25, stands rejected under 35 U.S.C. 102(e), as being anticipated by U.S. Patent 6,594,313 to Hazra et al.

(B) The invention, as claimed in claims 7-12 and 19-24, stands

rejected under 35 U.S.C. 103(a), as being unpatentable over

Hazra et al. in view of U.S. Patent 6,480,615 to Sun et al.

(vii) Arguments

(A) The Hazra et al. patent discloses increased video playback

framerate in low bit-rate video applications, in which an

interpolated frame intermediate of a frame pair is synthesized

based on a variety of methods.

The subject invention, as claimed in claim 1, relates to a

method for detecting of motion at a temporal intermediate position

between a previous and a next image, in which the method comprises

optimizing a criterion function for candidate vectors, said

criterion function depending on data from both the previous and

next images, the optimizing being carried out "at the temporal

intermediate position in non-covering and non-uncovering areas". In

particular, the method of the subject invention, as claimed in

claim 1, comprises that "the optimizing is carried out at the

temporal position of the next image in covering areas and at the

temporal position of the previous image in uncovering areas."

Appellants would like to point out that it is well-founded

that "A claim is anticipated only if each and every element as set

forth in the claim is found, either expressly or inherently

described, in a single prior art reference." *Verdegaal Bros.* v.

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Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053

(Fed. Cir. 1987), and "The identical invention must be shown in as

complete detail as is contained in the ... claim." *Richardson v.*

Suzuki Motor Co., 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed.

Cir. 1989).

The Examiner has indicated in the rejection that the above

limitations may be found in Hazra et al. at col. 1, lines 52-66.

This portion of Hazra et al. states:

> "Additionally, the best-matched block for each
> interpolated block is selected from the current winning
> block for each list based on an error criterion and an
> overlap criterion. The interpolated frame is
> synthesized based on the best-matched block for each
> interpolated block.
> "In another embodiment, a method includes
> selecting a zero motion vector for a given pixel in an
> interpolated frame upon determining a current pixel in
> a current frame corresponding to the given pixel in the
> interpolated frame is classified as covered or
> uncovered. The interpolated frame is synthesized based
> on selecting the zero motion vector for the given pixel
> in the interpolated frame upon determining the current
> pixel in the current frame corresponding to the given
> pixel in the interpolated frame is classified as
> covered or uncovered."

Appellants submit that while Hazra et al. mentions the terms

"covered" and "uncovered", a careful reading of the above will

indicate that there is not disclosure in Hazra et al. "that the

optimizing is carried out at the temporal position of the next

image in covering areas and at the temporal position of the

previous image in uncovering areas." Rather, Hazra et al.

specifically states "the interpolated frame is synthesized based on

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selecting the zero motion vector for the given pixel in the interpolated frame upon determining the current pixel in the current frame corresponding to the given pixel in the interpolated frame is classified as covered or uncovered."

In response thereto the Examiner now states:

> "Hazra '313 (figs. 3 and 4) discloses, process for determining best motion vector (candidate vectors, best match) between the current/new image/frame (as covering area), which has its own vector (which also consider next image with respect to the previous image) and previous image/frame (as uncovering area), which are situated temporally between the frames/blocks. The best-matched vector is being selected, is in fact a process of optimizing."

Appellants submit that the Examiner is mistaken. In particular, Fig. 3 is a block diagram showing merely 4 blocks, to wit, classifying pixels 300, dividing the framing into blocks 302, determining a best motion vector 304 and synthesizing the interpolated frame 306. Fig. 4 merely shows a previous frame with a particular block 406, a current frame in which, due to motion, the corresponding block is 410, and the interpolated frame where the corresponding block is 408. It should be apparent that these two figures do not show that in non-uncovered and non-covered areas optimizing is carried out at the temporal intermediate position, in covering areas, optimizing is carried out at the temporal position of the next image, and in uncovering areas, optimizing is carried out at the temporal position of the previous image.

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Further, from the Examiner's statement, it is apparent that there is a misunderstanding of the meaning of the terms "covering" and "uncovering". In particular, the terms "covering" and "uncovering" do not mean the current image and the previous image, respectively. Rather, "covering" and "uncovering" are related to motion vectors in the vicinity of an edge. [Appellants had attempted to further illustrate the difference between "covering" and "uncovering" by submitting a copy of WO 00/11863 cited on pages 3 and 12 of the subject specification. However, this reference was not considered by the Examiner.]

In Hazra et al., use is made of the forward motion vector or the backward motion vector. However, in the event that a pixel is classified as either covered or uncovered, a zero motion vector is chosen (see col. 6, lines 63-67). As such, Hazra et al. definitely does not disclose the limitation "that the optimizing is carried out at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas."

Claim 3 states "the criterion function is a match error which is minimized."

The Examiner indicates that this is shown in Hazra et al. at col. 6, lines 25-35, which states:

> "In FIG. 5, block 514 is performed in one embodiment by the method of FIG. 8, as the final motion vector is selected from one of the candidate lists. In FIG. 8 in block 808, the selection criterion from among

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the three candidates, Forward Motion Vector (FMV)
Candidate 802, Backward Motion Vector (BMV) Candidate
804 and Zero Motion Vector (ZMV) Candidate 806, from
the candidate lists uses both the block matching error
(MAD or the Sum of Absolute Difference (SAD)) and the
overlap to choose the best motion vector. The rationale
for using the block matching error is to penalize
unreliable motion vectors even though they may result
in a large overlap."

Appellants submit that it should be clear from the above that
while Hazra et al. arguably does perform a block matching error to
choose the best motion vector, this is not what is done in the
invention as claimed. Rather, claim 1 states that "optimizing (of
the criterion function) is carried out at the temporal position of
the next image in covering areas and at the temporal position of
the previous image in uncovering areas."

Appellants submit that it appears that Hazra et al. is
performing a block match error analysis on all the motion vector
candidates as opposed to, selectively, the forward motion vectors,
the backward motion vectors, and the zero motion vectors. In the
subject invention, depending on whether there is covering or
uncovering, or areas of non-uncovering or non-covering,
optimization is performed at differing temporal positions, i.e.,
the temporal position of the (intermediate) interpolated image, the
temporal position of the next image, or the temporal position of
the previous image.

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(B) The above arguments with regard to Hazra et al. are incorporated herein by reference.

The Sun et al. patent discloses motion estimation within a sequence of data frames using optical flow with adaptive gradients, in which Sun et al. "mentions" the terms "occlusions" and "edge" (at col. 3, lines 5-50).

However, Appellants submit that Sun et al. neither shows nor suggests determining a velocity edge, marking an occlusion area around the determined edge, and replacing the foreground velocity by background velocity or reversibly dependent on whether the occlusion is a covering or uncovering area, the sign of the foreground velocity and on which side of the velocity edge the foreground is (as specifically claimed in claim 7).

Furthermore, since the rejection is the combination of Hazra et al. and Sun et al., Appellants submit that Sun et al. does not supply that which is missing from Hazra et al., i.e., "that the optimizing is carried out at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas."

Based on the above arguments, Appellants believe that the subject invention is neither anticipated nor rendered obvious by the prior art and is patentable thereover. Therefore, Appellants respectfully request that this Board reverse the decisions of the Examiner and allow this application to pass on to issue.

Respectfully submitted,

by _Edward W. Goodman_
Edward W. Goodman, Reg. 28,613
Attorney

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(viii)   Claim Appendix

CLAIMS ON APPEAL

1.   (Amended)   A method for detecting motion at a temporal intermediate position between previous and next images, in which a criterion function for candidate vectors is optimized, said function depending on data from both previous and next images and

5   in which the optimizing is carried out at the temporal intermediate position in non-covering and non-uncovering areas, characterized in that the optimizing is carried out at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas.

2.   (Amended)   The method as claimed in claim 1, wherein the previous image is shifted over a fraction a times the candidate vector, the next image is shifted over 1 -a times the candidate vector and the fraction a may change within the image period.

3.   (Amended)   The method as claimed in claim 1, wherein the criterion function is a match error which is minimized.

4.   (Amended)   The method as claimed in claim 2, wherein the fraction a is controlled by a covering/uncovering detector in the matching process.

5.   (Amended)   The method as claimed in claim 4, wherein the
fraction a is set to 1 in case of covering and set to 0 in case of
uncovering.

6.   (Amended)   The method as claimed in claim 4, wherein the
covering/uncovering detector decides on data in a previous image to
the fraction a in the current estimation.

7.   (Amended)   The method as claimed in claim 1, wherein a
velocity edge X_E is determined, an occlusion area is marked around
said edge, and in said occlusion area, foreground velocity is
replaced by background velocity or reversibly dependent on whether
5   the occlusion area is a covering or uncovering area, the sign of
the foreground velocity and on which side of the velocity edge X_E
the foreground is.

8.   (Amended)   The method as claimed in claim 7, wherein at the
position $\bar{x}_1$ of a velocity edge

• a first position $\bar{x}_a$ in the previous (covering) or next
(uncovering) image is calculated by shifting $\bar{x}_1$ over the first
5   vector at one side of the edge

• a second position $\bar{x}_b$ in the previous (covering) or next
(uncovering) image is calculated by shifting $\bar{x}_1$ over the second
vector at the other side of the edge

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- and a third intermediate position between $\vec{x}_a$ and $\vec{x}_b$ is

10 calculated

- while finally, the vector fetched with $v_{\tilde{a}v}$ at the third position

in the previous (covering) or next (uncovering) image is filled in

those regions of the image in the environment of the edge, to which

no vector is projected, in case the background vector $v_{\tilde{B}G}$ should be

15 filled in, and the vector chosen between $\vec{D}(\vec{x} - \begin{pmatrix} 1 \\ 0 \end{pmatrix}, n)$ and $\vec{D}(\vec{x} + \begin{pmatrix} 1 \\ 0 \end{pmatrix}, n)$

which is most different from $v_{\tilde{a}v}$ is filled in, in case a foreground

vector $v_{\tilde{F}G}$ should be filled in.

9. (Amended)   The method as claimed in claim 8, wherein the

intermediate position is $(\vec{x}_a + \vec{x}_b)/2$.

10. (Amended)   The method as claimed in claim 7, wherein a
background velocity is identified as a velocity which crosses the
velocity discontinuity and projects to a foreground velocity in the
previous picture, whereas a foreground velocity projects to itself.

11. (Amended)   The method as claimed in claim 7, wherein near
edges it is tested whether the mentioned edge has moved over the
first vector on one side of the edge, or over the second vector on
the other side of the edge, in case the edge moves with the first

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5   (second) vector, the second (first) vector is filled in those

regions of the projected vector field in the environment of the

edge, to which no vector is projected, in case a background vector

v_{BG} should be filled in, and the other vector is filled in, in case

a foreground vector v_{FG} should be filled.

12.   (Amended)   The method as claimed in claim 10, wherein the

crossing from a background region to a foreground region in the

previous image is verified by the match error of the vector in that

block.

13.   (Amended)   An apparatus for detecting motion at a temporal

intermediate position between previous and next images, comprising

means for optimizing a criterion function for candidate vectors,

said function depending on data from both previous and next images

5   in which the optimizing is carried out at the temporal intermediate

position in non-covering and non-uncovering areas, characterized in

that said apparatus further comprises means for detecting covering

or uncovering areas, wherein the optimizing is carried out at the

temporal position of the next image in covering areas and at the

10   temporal position of the previous image in uncovering areas.

14.   (Amended)   The apparatus as claimed in claim 13, wherein the

previous image is shifted over a fraction a times the candidate

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vector, the next image is shifted over $1-\alpha$ times the candidate vector and the fraction α may change within the image period.

15. (Amended)   The apparatus as claimed in claim 13, wherein the criterion function is a match error which is minimized.

16. (Amended)   The apparatus as claimed in claim 14, wherein said apparatus further comprises a covering/uncovering detector for controlling the fraction α in the matching process.

17. (Amended)   The apparatus as claimed in claim 16, wherein the fraction α is set to 1 in case of covering and set to 0 in case of uncovering.

18. (Amended)   The apparatus as claimed in claim 16, wherein the covering/uncovering detector decides on data in a previous image to the fraction α in the current estimation.

19. (Amended)   The apparatus as claimed in claim 13, wherein a velocity edge X_E is determined, an occlusion area is marked around said edge, and in said occlusion area, foreground velocity is replaced by background velocity or reversibly dependent on whether
5   the occlusion area is a covering or uncovering area, the sign of

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the foreground velocity and on which side of the velocity edge X_B

the foreground is.

20.   (Amended)   The apparatus as claimed in claim 19, wherein

said apparatus further comprises calculation means for, at the

position $\vec{x}_1$ of a velocity edge, calculating

* a first position $\vec{x}_a$ in the previous (covering) or next

5 (uncovering) image by shifting $\vec{x}_1$ over the first vector at one side

of the edge

* a second position $\vec{x}_b$ in the previous (covering) or next

(uncovering) image by shifting $\vec{x}_1$ over the second vector at the

other side of the edge

10   * and a third intermediate position between $\vec{x}_a$ and $\vec{x}_b$,

* while finally, the vector fetched with v_{av} at the third position

in the previous (covering) or next (uncovering) image (9) is filled

in those regions of the image in the environment of the edge, to

which no vector is projected, in case the background vector $v_{\bar{B}G}$

15   should be filled in, and the vector chosen between $\vec{D}(\vec{x} - \begin{pmatrix} 1 \\ 0 \end{pmatrix}, n)$ and

$\vec{D}(\vec{x} + \begin{pmatrix} 1 \\ 0 \end{pmatrix}, n)$ which is most different from v_{av} is filled in, in case a

foreground vector $v_{\bar{F}G}$ should be filled in.

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21. (Amended)   The apparatus as claimed in claim 20, wherein the

intermediate position is $(\vec{x}_a + \vec{x}_b)/2$.

22. (Amended)   The apparatus as claimed in claim 19, wherein

said apparatus further comprises means for projecting two positions

on either side of the edge to the previous (covering) or next

(uncovering) image, in which a background velocity is identified as

5   a velocity which crosses the velocity discontinuity and projects to

a foreground velocity in the previous picture, whereas a foreground

velocity projects to itself.

23. (Amended)   The apparatus as claimed in claim 19, wherein

said apparatus further comprises means for testing near edges

whether the mentioned edge has moved over the first vector on one

side of the edge, or over the second vector on the other side of

5   the edge, in case the edge moves with the first (second) vector,

the second (first) vector is filled in those regions of the

projected vector field in the environment of the edge, to which no

vector is projected, in case a background vector v_{BG} should be

filled in, and the other vector is filled in, in case a foreground

10   vector $v_{\bar{F}G}$ should be filled.

24. (Amended)   The apparatus as claimed in claim 22, wherein

said apparatus further comprises verification means for verifying

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the crossing from a background region to a foreground region in the previous image by the match error of the vector in that block.

25. (Amended)   An image display apparatus comprising apparatus for detecting a motion vector as claimed in claim 13, means for interpolating image parts connected to said detecting apparatus, and a display device connected to the interpolating means.

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(ix)   <u>Evidence Appendix</u>

There is no evidence which had been submitted under 37 C.F.R. 1.130, 1.131 or 1.132, or any other evidence entered by the Examiner and relied upon by Appellants in this Appeal.

(x)   <u>Related Proceedings Appendix</u>

Since there were no Proceedings identified in section (ii)
herein, there are no decisions rendered by a court or the Board in
any proceeding identified pursuant to paragraph (c)(1)(ii) of 37
C.F.R. 41.37.

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